

# Biology of the Wild rabbit, *Oryctolagus cuniculus*, in southern Sweden

## V. Seasonal variation of weight of the anal and inguinal glands<sup>1</sup>

By M. DAHLBÄCK, and M. ANDERSSON

*Pharmacological Department, AB Draco, Lund, and  
Department of Zoology, University of Lund, Sweden*

*Receipt of Ms. 22. 5. 1981*

### Abstract

Studied seasonal development of the anal and inguinal glands in male and female wild rabbits in southern Sweden. In both sexes, the size of the glands was strongly correlated with the sexual development. Maximal sizes of the glands were attained during the intense breeding period, April to August.

### Introduction

An investigation of the reproductive biology of the wild rabbit has been in progress in southern Sweden since 1972 (cf. ANDERSSON and MEURLING 1977; BORG et al. 1978; ANDERSSON et al. 1979a, 1979b; DAHLBÄCK and ANDERSSON 1981). The present paper, which is a result of this investigation, describes the seasonal weight changes of the anal and inguinal glands, two of the main odoriferous skin glands in the rabbit. Both glands are stimulated by androgens, especially testosterone (MYKYTOWYCZ 1966a, b; SALESES and MAROIS 1969; STRAUSS and EBLING 1970; WALES and EBLING 1971; EBLING 1972), for which reason it was of interest to compare the seasonal patterns of these glands with the sexual cycles (described by ANDERSSON et al., 1979b). The importance of the odoriferous glands in the social behaviour of the wild rabbit is well-known (see MYKYTOWYCZ 1964, 1967, 1968, 1970, 1972, 1973, 1974 for reviews).

Secretions of the anal gland (consisting of two lobes lying lateral to the rectum) give the faecal pellets a very distinctive odour (MYKYTOWYCZ 1966a; HESTERMAN and MYKYTOWYCZ 1968). The odour, thus distributed by the faeces, plays an important role in marking territorial boundaries (MYKYTOWYCZ 1966a, 1968). The inguinal glands lie in a skin pouch on either side of the rectum and penis or vagina. The inguinal odour is apparently associated with sexual attraction and individual identification (MYKYTOWYCZ 1966a; MYKYTOWYCZ et al. 1976; STRAUSS and EBLING 1970). References to papers concerning the gross anatomy and histology of the anal and inguinal glands are given by MYKYTOWYCZ (1966a, 1966b).

### Material and methods

Rabbits of both sexes were shot as monthly samples in the Revinge area, approx. 20 km east of Lund in southern Sweden; for details see ANDERSSON et al. (1979b). The animals were weighed, dissected, and various organs, including the anal and inguinal (apocrine plus sebaceous portion) glands, were

<sup>1</sup> This work was supported by grants from the Swedish Natural Science Research Council.

Fig. 1. Seasonal variation of weight of the anal and inguinal glands in yearling and subadult wild rabbits. a. males (n = 306, mean sample size = 18.6); b. females (n = 307, mean sample size = 20.4). Continuous line = cleaned body weight (g); dotted line = weight (mg) of inguinal glands (I); dashed line = weight (mg) of anal glands (A); y = yearlings; sa = subadults; vertical bars denote S.E.

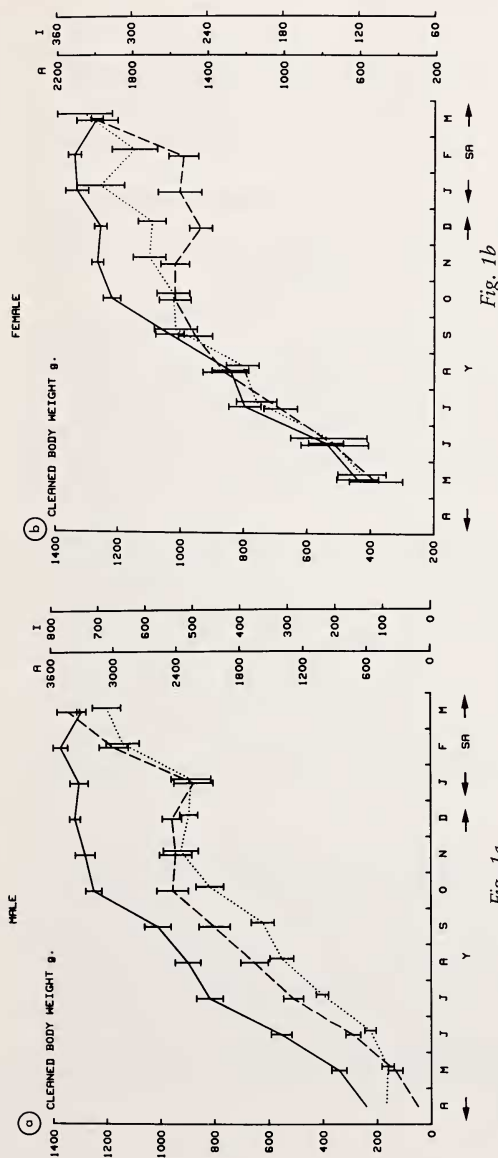


Fig. 1a

Fig. 1b

Fig. 2. Seasonal variation of weight of the anal and inguinal glands in adult wild rabbits. a. males (n = 224, mean sample size = 25.5). Continuous line = testicular (T) weights (mg); the inguinal gland mean in April excluded (see text). b. females (n = 245, mean sample size = 27.9). Continuous line = ovarian (O) weights (mg); dotted line = weight (mg) of inguinal glands (I); dashed line = weight (mg) of anal glands (A); cross-hatched areas indicate the most intense breeding period; vertical bars denote S.E.

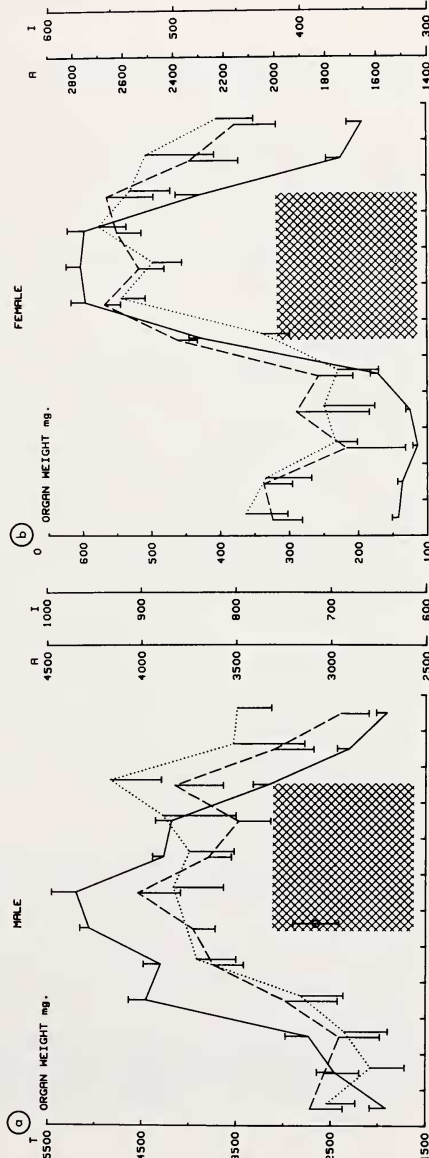


Fig. 2a

Fig. 2b

weighed fresh and fixed in Bouin's fluid. The eye lenses, for use in age separation of the animals, were secured with the technique described by LORD (1960). A total of 1082 specimens from the period March 1972 to December 1975 were studied.

The monthly weight distribution of the eye lenses enabled separation of the animals into two main age categories: one consisted of yearlings (until December) and subadults (January until onset of breeding in March); the other, of adults (for details, see ANDERSSON *et al.* 1979b).

It was justified to pool the material because the monthly changes in gland weights differed only insignificantly between the years (not illustrated) and the annual reproductive activity was quite uniform during the period studied (ANDERSSON *et al.* 1979b).

Testicular and ovarian weights were used as indicators of sexual activity.

## Results and discussion

The anal and inguinal glands of the yearling population of both sexes increased steadily in weight from May to October (fig. 1), presumably due to cell proliferation during this period of prepubertal body growth. Mitotic activity is fairly common in the inguinal gland of the growing rabbit, but rare in the adult (MONTAGNA 1959). It is reasonable to assume similar conditions in the anal gland.

After a short period of retarded growth (less pronounced in the female inguinal gland), there was a new weight increase from January onwards. This weight increase in the subadult population, not associated with any general body enlargement (fig. 1), is probably due to rising levels of stimulating steroid hormones associated with puberty.

The anal and inguinal glands of the adults ran through an annual cycle (fig. 2). After reaching peak values during the most intense breeding period between April and August, the weights began to decline, reaching the lowest values in December–January, during the non-breeding period. However, from January on the development of the glands differed with sex. In the males the gland weights began to increase, while in the females they remained low and did not seem to be influenced by the approaching breeding season until later. This sexual difference is evidently due to a fundamental difference in the fertility cycle.

Whereas the male fertility, reflected by increasing testicular weights (fig. 2a), increased from January onwards, a corresponding ovarian increase, due to corpora lutea formation, did not occur until two months later. These differences were, of course, expected.

A weight increase of the anal and inguinal glands implies increased secretion (MYK-TOWYCZ 1966a, b; WALES and EBLING 1971). The main hormone involved in this stimulation in the male is evidently testosterone. This steroid may also be the stimulating one in the female since in the rabbit the ovary secretes significant amounts of testosterone after mating (HILLIARD *et al.* 1974). However, metabolic conversion of corpus luteum progesterone is probably a more significant source of testosterone. The well-known antagonistic effect of estrogen on skin glands probably explains why the glands in the females are lighter (fig. 2).

The time of year of birth will, of course, affect the glandular development in an individual rabbit in the yearling population. However, the fairly short breeding season in the study area (March to August) reduces these differences. In the adults it is reasonable to assume that the glandular development is no longer age-dependent to any appreciable extent. Of course, the transition from age-dependent to non age-dependent glandular development occurs gradually in the present kind of material with rather "rough" age-categories. In young individuals, defined as adults, a certain amount of age-dependent gland development can still be present and cause unexpected deviations in the material. This is why the mean weight of the inguinal gland in the male adults in April (fig. 2a), is considered too low and therefore excluded.

## Zusammenfassung

*Biologie des Wildkaninchens, Oryctolagus cuniculus, in Südschweden. V. Saisonale Variation der Gewichte von Anal- und Inguinaldrüsen*

Die Gewichtsänderungen der Anal- und Inguinaldrüsen männlicher und weiblicher Wildkaninchen im Jahreslauf wurden in Südschweden untersucht. In beiden Geschlechtern war die Drüsenentwicklung mit der Gonadengröße eng korreliert. Höchstgewichte erreichten die Drüsen während der Zeit intensivster Fortpflanzung von April bis August.

## References

- ANDERSSON, M.; MEURLING, P. (1977): The maturation of the ovary in wild rabbits, *Oryctolagus cuniculus*, in South Sweden. Acta zool. **58**, 95–101.
- ANDERSSON, M.; BORG, B.; MEURLING, P. (1979a): Biology of the wild rabbit, *Oryctolagus cuniculus*, in southern Sweden. II. Modifications in the onset of breeding in relation to weather conditions. Swedish Wildl. Res. (Viltrevy) **11**, 129–137.
- ANDERSSON, M.; DAHLBÄCK, M.; MEURLING, P. (1979b): Biology of the wild rabbit, *Oryctolagus cuniculus*, in southern Sweden. I. Breeding season. Swedish Wildl. Res. (Viltrevy) **11**, 103–127.
- BORG, B.; ANDERSSON, M.; MEURLING, P. (1978): Biology of the wild rabbit, *Oryctolagus cuniculus*, in southern Sweden. III. Histology of the uterus in the non-breeding season. Acta zool. **59**, 253–260.
- DAHLBÄCK, M.; ANDERSSON, M. (1981): Biology of the wild rabbit, *Oryctolagus cuniculus*, in southern Sweden. IV. Leyding cell activity and seasonal development of two male accessory organs of reproduction. Acta zool. **62**, 113–120.
- EBLING, F. J. (1972): The response of the cutaneous glands to steroids. Gen. Comp. Endocrinol., Suppl. **3**, 228–237.
- HESTERMAN, E. R.; MYKYTOWYCZ, R. (1968): Some observations on the odours of the anal gland secretions from the rabbit, *Oryctolagus cuniculus* (L.). CSIRO Wildl. Res. **13**, 71–81.
- HILLIARD, J.; SCARAMUZZI, R. J.; PANG, C.-N.; PERNARDI, R.; SAWYER, C. H. (1974): Testosterone secretion by rabbit ovary in vivo. Endocrinology **94**, 267–271.
- LORD, D. R. (1960): The lens as an indicator of age in cottontail rabbits. J. Wildl. Mgmt. **23**, 358–360.
- MONTAGNA, W. (1950): The brown inguinal glands of the rabbit. Am. J. Anat. **87**, 213–237.
- MYKYTOWYCZ, R. (1964): Territoriality in rabbit populations. Austr. Natur. Hist. **14**, 326–329.
- (1966a): Observations on the odoriferous and other glands in Australian wild rabbit, *Oryctolagus cuniculus* (L.), and the hare, *Lepus europaeus* P. I. The anal gland. CSIRO Wildl. Res. **11**, 11–29.
- (1966b): Observations on the odoriferous and other glands in the Australian wild rabbit, *Oryctolagus cuniculus* (L.), and the hare, *Lepus europaeus* P. II. The inguinal glands. CSIRO Wildl. Res. **11**, 49–64.
- (1967): Communication by smell in the wild rabbit. Proc. ecol. Soc. Aust. **2**, 125–131.
- (1968): Territorial marking by rabbits. Sci. Amer. **218**, 116–126.
- (1970): The role of skin glands in mammalian communication. In: Advances in chemoreception. Ed. by J. W. JOHNSTON, D. G. MOULTON and A. TURK. Vol. **1**, 327.
- (1972): The behavioural role of the mammalian skin glands. Naturwiss. **59**, 133–139.
- (1973): Reproduction of mammals in relation to environmental odours. J. Reprod. Fert., Suppl. **19**, 433–446.
- (1974): Odour in the spacing behaviour of mammals. In: Pheromones. Ed. by M. C. BIRCH.
- MYKYTOWYCZ, R.; HESTERMAN, E. R.; GAMBALE, S.; DUDZINSKI, M. L. (1976): A comparison of the effectiveness of the odors of rabbits, *Oryctolagus cuniculus*, in enhancing territorial confidence. J. Chem. Ecol. **2**, 13–24.
- SALESSES, A.; MAROIS, M. (1969): Contribution a l'étude du controle hormonale de deux glandes d'origine ectodermique: sensibilité des glandes anales et inguinales du lapin à la testosterone et à l'oestradiol. C. r. Ass. Anat. **143**, 1458–1467.
- STRAUSS, J. S.; EBLING, F. J. (1970): Control and function of skin glands in mammals. Mem. Soc. Endocrinol. **18**, 341–371.
- WALES, N. A. M.; EBLING, F. J. (1971): The control of the apocrine glands of the rabbit by steroid hormones. J. Endocr. **51**, 763–770.
- Authors' addresses:* MAGNUS DAHLBÄCK, Pharmacological Department, AB Draco, Box 1707, S-221 01 Lund, Sweden; MATS ANDERSSON, Department of Zoology, University of Lund, Helgonavägen 3, S-223 62 Lund, Sweden